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## (54) IMPROVEMENTS IN OR RELATING TO ELECTRICAL SWITCHES

(71) We, SUMLOCK ANITA ELECTRONICS LIMITED a British Company of Anita House, Rockingham Road, Uxbridge, Middlesex do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This circuit has reference to electrical switches; particularly, but not solely, to electrical switches included in a circuit formed on or in a substrate material in sheet or block form. By the term 'substrate material' is meant the material which mainly determines the physical properties — principally rigidity — of the combination of the material and the circuits formed on or in the material, examples of such 'substrate materials' are the sheet of insulating material of a printed circuit board and the substrate material of an integrated circuit. The term 'electrical switch' includes any form of switch that can be operated by pressure.

An electrical switch is known which consists of an integrated circuit board having on it a pair of contacts connected to one part of a circuit to be switched and a single contact which is centrally situated with respect to the pair of contacts and which is connected to the other part of the circuit to be switched. The three contacts are in a 'well' formed by a circular aperture in a sheet placed on the contact side of the integrated circuit board. A domed, metallic, circular diaphragm is placed within the 'well' to abut the pair of contacts but not to abut the single central contact so as to form a normally-open switch. The diaphragm 'well' is covered by a flexible insulating material. When the diaphragm is depressed, the diaphragm is distorted and abruptly domes in the opposite direction to abut the single contact as well as the pair of contacts so as to form a closed switch. When the diaphragm is released, it

abruptly domes back to the open-switch condition again. This known form of electrical switch has the disadvantage that the movement of the diaphragm between the open and closed positions is very small and in consequence is unattractive to many potential customers.

According to one aspect of the invention there is provided a means for operating an electrical switch which is operated by the abrupt distortion of a domed metallic disc diaphragm, the operating means including a first member, a second member for abutment against the electrical switch and a resilient member connecting the first member and the second member so that when the first member is moved to operate the switch the resilient member absorbs the first part of this first member movement and transmits the remaining part of the first member movement to the second member to operate the switch.

The operating means is preferably slidably mounted on a mounting plate adjacent the electrical switch.

The first member of the operating means is preferably slidably mounted on the mounting plate.

The first member of the operating means is preferably arranged for manual movement.

The mounting plate is preferably attached to the electrical switch.

According to another aspect of the present invention there is provided an electrical switch which is operated by the abrupt distortion of a domed metallic disc diaphragm, the switch including a base plate assembly having an electrical switch therein or thereon; a means for operating the electrical switch, the operating means including a first member, a second member for abutment against the electrical switch and a resilient member connecting the first member and the second member so that when

the first member is moved to operate the switch the resilient member absorbs the first part of the first member movement and transmits the remaining part of the first member movement to the second member to operate the switch; and a means for mounting the operating means to the base plate assembly.

The first member of the operating means is preferably slidably mounted on the mounting means.

The first member of the operating means is preferably arranged for manual movement.

Constructional embodiments will now be described, by way of examples only, with reference to the drawings accompanying the provisional specification wherein:

Figure 1 shows a cross-sectioned front elevation of a first electrical switch made according to the invention;

Figure 2 shows a partial plan of the electrical switch shown in Figure 1 viewed in the direction of arrow X;

Figure 3 shows a partial plan of the electrical switch shown in Figure 1 viewed in the direction of arrow Y, and

Figure 4 shows a partial cross-sectioned front elevation of a second electrical switch made according to the invention.

The first electric switch 1 shows a base plate assembly 2 which comprises a substrate 6 in the form of a sheet of insulating material, for example fibre glass, having on one surface a printed circuit (Figures 2 and 3, but only partly shown) which circuit includes one part 10 of a circuit to be switched and another part 12 of the circuit to be switched. The parts 10 and 12 of the printed circuit are connected to a pair of contact members 14 and a single contact 16 respectively within an area defined by an aperture 18 in a sheet of insulating material 22 which is attached to the other surface of the substrate 6. The contact members 14 are U-shaped gold-plated wires the ends of which pass through apertures 24 in the substrate 6 and are connected by solder to the circuit part 10. The single member 16 is also U-shaped gold-plated wire the ends of which pass through apertures 24 which are aligned between the apertures 24, and are connected by solder to the circuit part 12. A domed metallic disc diaphragm 26 made of beryllium copper or a similar material is placed in the aperture 18 of the insulating material 22 the dome uppermost so that the diaphragm 26 rests on the pair of contact elements 14 but is away from the single contact element 16 to form an electrical switch. The diaphragm 26 is retained in contact with the pair of contact elements 14 by a sheet of transparent and adhesive insulating material 28. The base plate assembly 2 just described is available as a

multi-switch keyboard unit from Texas Instruments Incorporated as the IKS Series Mechanical keyboard.

A first member in the form of a key-top 30 is mounted above the diaphragm 26 by a mounting means in the form of a keyboard mounting plate 32. The key top 30 is movable towards and away from the diaphragm 26 by movement of the key top 30 in an aperture 34 in the mounting plate 32. A resilient member in the form of an open-coiled helical spring 36 has a second member in the form of a domed contact 38 at one end; this contact 38 abuts the insulating material 28 at or near the highest point of the dome of the diaphragm 26. The other end of the spring 36 abuts the underside of the key top 30 and causes the key top 30 to project out of the aperture 34 in the mounting plate 32.

In operation the key top 30 is depressed and for the first part of the key top movement, say a movement of three-thirty seconds of an inch, the open coils of the helical spring 36 are closed to absorb the key top movement. When the helical spring is compressed the remaining key top movement, which is equal at least to the movement required to operate the switch, is transmitted by the compressed spring 36 to the contact 38. The contact 38 pushes against the insulating material 28 and the diaphragm 26 to deform the domed shape of the diaphragm until the diaphragm abruptly changes to a domed shape which is curved in the opposite direction and in which it is in contact with the single contact element 16 and the pair of contact elements 14 to make an electrical circuit between the circuit part 10 and the other circuit part 12. When the key top is released, the diaphragm 26 and the helical spring 36 return to their original conditions.

The second electrical switch 1' shown in Figure 4 has a base plate assembly 2 which is the same as that previously described. A key top 30' is mounted above the diaphragm 26 by means of a keyboard mounting plate 32'. The key top 30' has a flanged first part 40, which slides in an aperture 41 of the mounting plate 32' which has a recess 42 for the flange 43 of the first part 40; and a second part 44 having its outer surface 45 axially movable over an inner circular recess 46 of the first part 40 against the same helical spring 36 as that previously described. The second part 44 has a part-spherical contact 47 on the face adjacent the diaphragm 26. The spring 36 urges the contact 47 of the second part 44 against the insulating material 28 to abut the diaphragm 26 and urges the flange 43 of the first part 40 against the top face of the recess 42. The operation of the second elec-

trical switch 1<sup>1</sup> is essentially the same as previously described with regard to the first electric switch 1.

Switch-operating means, for example the key top 30 or 30<sup>1</sup>, made according to the invention can be used to modify the operating movement of other electrical switches which are commercially available.

The resilient member is not restricted to a helical spring or any other form of spring, but includes any material in any shape which can exhibit the property of resilience to perform in the way previously described.

The electric switches 1 or 1<sup>1</sup> can be modified to be latched down in the closed position until a further depression releases the latch to open the switch.

The electric switches 1 or 1<sup>1</sup> can be one of a plurality of electric switches on a calculating machine keyboard; such electric switches can be used for the eleven key switches representing the digits 0 to 9 and the decimal point respectively, the arithmetic functions performed by the calculating machines and the latchable on/off and other such switches.

#### WHAT WE CLAIM IS:—

1. A means for operating an electrical switch which is operated by the abrupt distortion of a domed metallic disc diaphragm, the operating means including a first member, a second member for abutment against the electrical switch and a resilient member connecting the first member and the second member so that when the first member is moved to operate the switch the resilient member absorbs the first part of this first member movement and transmits the remaining part of the first member movement to the second member to operate the switch.

2. An operating means as claimed in claim 1, wherein the operating means is slidably mounted on a mounting plate adjacent the electrical switch.

3. An operating means as claimed in claim 2, wherein the first member of the operating means is slidably mounted on the mounting plate.

4. An operating means as claimed in any one of the preceding claims, wherein the

first member of the operating means is arranged for manual movement.

5. An operating means as claimed in any one of claims 2 to 4 wherein the mounting plate is attached to the electrical switch.

6. An operating means as claimed in claim 1, substantially as hereinbefore described with reference to Figures 1 or 4 of the drawings accompanying the Provisional Specification.

7. An electrical switch which is operated by the abrupt distortion of a domed metallic disc diaphragm, the switch including a base plate assembly having an electrical switch therein or thereon;

a means for operating the electric switch, the operating means including a first member, a second member for abutment against the electrical switch and a resilient member connecting the first member and the second member so that when the first member is moved to operate the switch the resilient member absorbs the first part of the first member movement and transmits the remaining part of the first member movement to the second member to operate the switch; and a means for mounting the operating means to the base plate assembly.

8. An electrical switch as claimed in claim 7 wherein the first member of the operating means is slidably mounted on the mounting means.

9. An electrical switch as claimed in claim 7 or 8 wherein the first member of the operating means is arranged for manual movement.

10. An electrical switch as claimed in claim 7, substantially as hereinbefore described with reference to Figures 1, 2 and 3 and Figures 2, 3 and 4 of the drawings accompanying the Provisional Specification.

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FIG. 1.

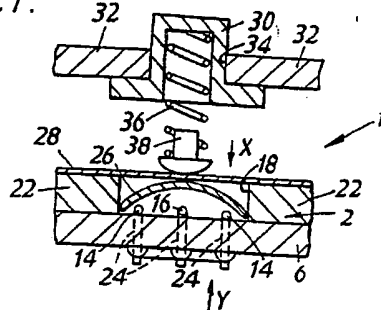


FIG. 2.

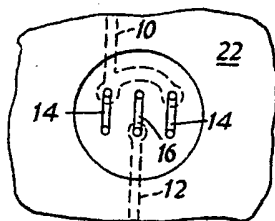


FIG. 3.

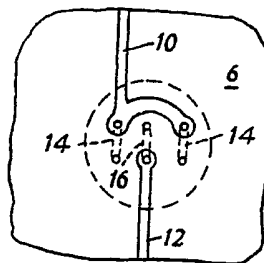


FIG. 4.

